NOTES ON *CONOCARPUS ERECTUS* (COMBRETACEAE) IN THE BAJA CALIFORNIA PENINSULA, MEXICO

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ABSTRACT

Mangrove stands of *Conocarpus erectus* in the semi-arid southern part of the Baja California Peninsula are rare, since the species reaches here its northern limit of distribution in the northern and western hemispheres. Four populations are described. Occurrence of these stands is relevant because this species seems to have responded positively to heavy rains over the last two decades. The coastal areas that have been favored maintain suitable levels of soil moisture so that populations of this species have been able of colonize new areas or showing a vigorous growth.

KEY WORDS: *Conocarpus erectus*, Baja California, mangrove, global change

RESUMEN

Las agrupaciones del mangle botoncillo *Conocarpus erectus* en el semi-árido sector sur de la Península de Baja California, México, son infrecuentes dado que en esta región la especie encuentra el límite norte de su distribución geográfica, tanto en los hemisferios norte y occidental. La presencia estas agrupaciones es relevante dado que los autores consideran que la especie a respondido positivamente a eventos que han dejado elevada humedad en el suelo de la franja costera de la zona en las últimas dos décadas, hecho que ha permitido a pequeñas poblaciones de esta especie colonizar nuevos puntos o reiniciar un activo crecimiento.

PALABRAS CLAVE: *Conocarpus erectus*, Baja California, manglar, cambio global

Primary environmental conditions required for establishing mangroves include water currents of low kinetic energy and a relatively high water temperature, i.e., higher than 20°C as the mean annual temperature (Lugo 1998). Along the west coast of the Baja California Peninsula, low winter temperatures and cold ocean currents seems act as the main controls for the spread of mangroves. Hence, mangroves on the Gulf of California side of the peninsula occur to 29°N at Bahía de Los Angeles (BA in Fig. 1) and near 27°N on the Pacific coast side at Laguna San Ignacio of the Estero El Coyote (EC in Fig. 1).

Mangrove species in the Baja California Peninsula are *Rhizophora mangle* L. (red mangrove, Rhizophoraceae), *Laguncularia racemosa* (L.) Gaertn. (white mangrove, Combretaceae), and *Avicenia germinans* (L.) L. (salty mangrove, Aviceniaceae). These three species typically grows as an association. Typically *R. mangle* and *L. racemosa* are permanently in touch with seawater and *A. germinans* grows landward in wet soil (Turner et al. 1995).

The button mangrove (*Conocarpus erectus* L., Combretaceae) is a common member of the mangrove association in tropical and subtropical zones in the Western Hemisphere. The species extends from the Caribbean Islands, including Bermuda and The Bahamas, through central Florida and northeastern Mexico and southward along the Atlantic coast to Brazil. On the Pacific coast, it extends from northern Mexico to northwestern Peru, including the Galapagos Islands. Also, it is found in western tropical Africa from Senegal to Zaire. The button mangrove is one of the more terrestrial mangrove species because it grows landward from the typical mangrove stands where soils are occasionally flooded. As with other mangroves, it is also present where the annual mean isotherm is above 20°C, avoiding near freezing temperatures (Robertson & Alongi 1992; Dawes 1998).

Typically, this species grows in brackish or saline silt along depositional coasts, behind mangrove stands immediately above the intertidal belt, as well as in coastal marshes, estuaries, inlets, and mudflats. It usually grows to a height of 8–10 m as an arborescent form (Tomlinson 1986). On the Pacific coast, button man-

grove extends marginally towards northwestern Mexico. Wiggins (1980) and Turner et al. (1995) recorded solitary individuals or small clumps on the Baja California Peninsula, south of 24°N at sites designated with cross marks (+) in Figure 1.

Compiling information about locations from vouchers of *C. erectus* in our herbarium and visiting these locations in recent years, as well as populations that were seen by informants, we present the following account of four sites where well structured populations of this species occur. In general terms, analysis is interesting because the southern part of the Peninsula (especially the Cape Region) is the northern limit of the geographical distribution in the northern and western hemisphere.

In the last decade, this area has received larger-than-typical volumes of rain (four hurricanes in six years: two 2001, one 2003, one 2006), which brought a few months of flooding and high water to the mouths of arroyos, estuaries, and salt marshes, typical habitats where the species has been collected. Our findings and analyses suggest that this species is currently undergoing population and regional expansion.

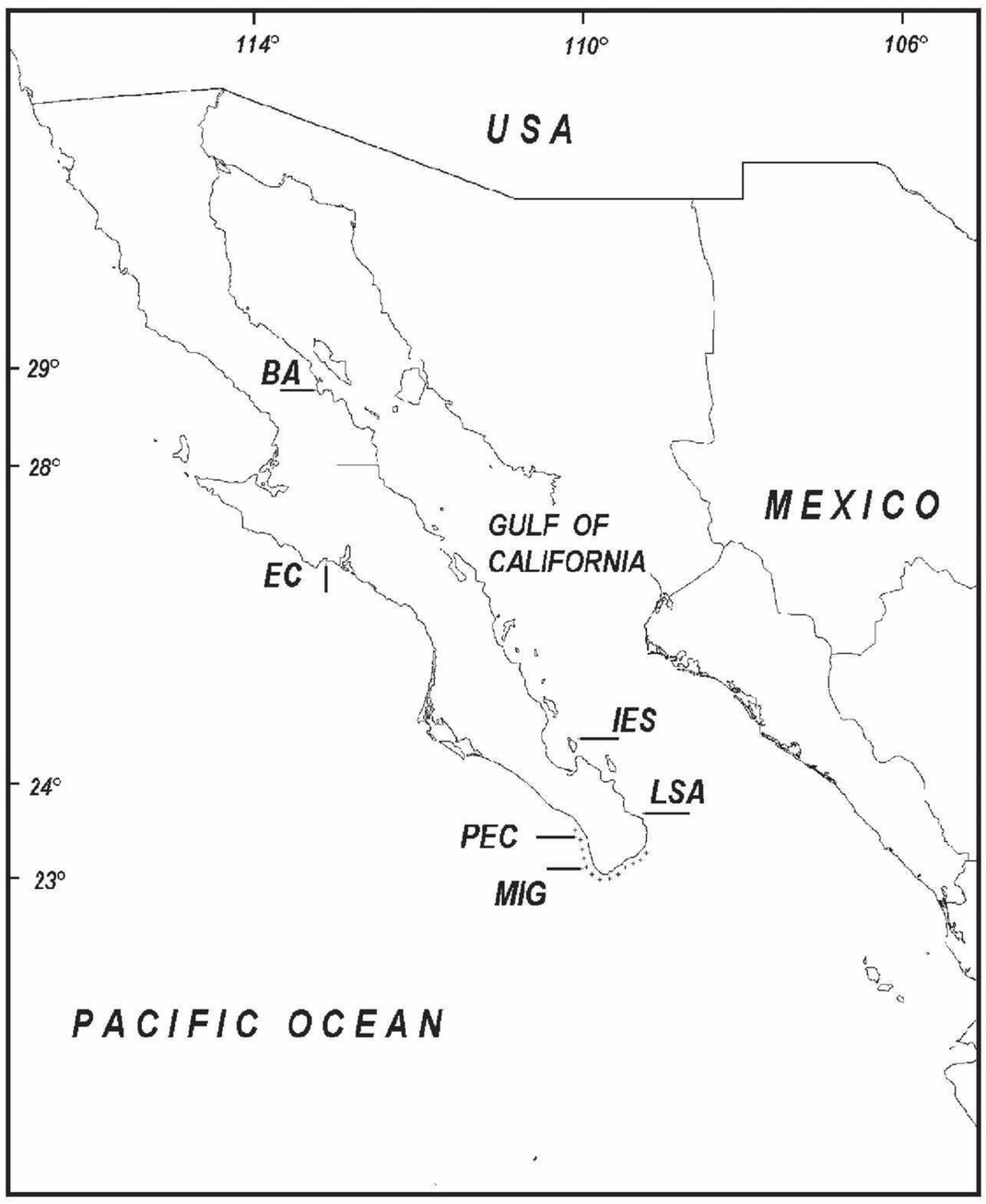

Fig. 1. Limits of four species of mangroves along the western coast of North America. Gulf of California shore line: BA = Bahía de Los Angeles (Rhizophora mangle, Avicenia germinans, and Laguncularia racemosa). Pacific shore line: EC = Estero El Coyote (R. mangle and L. racemosa). Stands of pure Conocarpus erectus in the Peninsula: IES = Isla Espiritu Santo, PEC = Plutarco Elías Calles, MIG = Migriño, and LSA = La Salina. Previously, isolated trees of C. erectus were reported on sandy beaches along the southwestern tip of the Baja California Peninsula (+).

Site 1: Isla Espíritu Santo (24°30'57.7" N, 110°23'11.4" W; IES in Fig. 1).
In the summer of 2002 (El Mezteño Cove), Felix Pico et al. (2005) found a stand of tree-like button mangrove on a narrow strip of land (130 m long) between a mudflat of sand and alkaline, clayey silt on the sea side and a colluvial, rocky soil with desert scrub on the land side. On a recent survey, the site contained a population of 87 plants. Measurements of height, two canopy diameters, and the basal perimeter of the trunk are shown in Table 1.

This is an old population because the community contains a majority of mature specimens with basal trunk circumference of up to 0.45 m, which suggests an age of several decades. No other mangrove species, of any size or age, is present near this cove.

Hurricanes strike this area irregularly. During summer 2001, Hurricane Juliette brought high seas that flooded the coves and bays on the west side of the island. At El Mezteño Cove, a break in the barrier beach allowed continuous ebb and flow of seawater through the new channel, which initiated expansion of the mangrove population, a condition that is clearly noticeable to visitors. Before 2001, the population seemed inconspicuous, probably from lack of an adequate water supply. During the summers of 2003 and 2006, Hurricanes Ignacio, Marti, and John renewed the tidal channel flow system, but the button mangrove did not show the vigorous growth seen in 2001–02.

Site 2: Plutarco Elías Calles (23°12'36.9"N, 110°08'24.8"W; PEC in Fig. 1)
This site is on the relatively cold Pacific coast side of the Baja California Peninsula in a salt marsh bordered with a strand of coastal dunes. This population is composed of tall individuals of shrubby habit with basal branching occupying an area bordering a mudflat. According to informants from the early 1990s, this population appears to be relatively young. This aspect is supported by the homogeneous basal perimeter of the

TABLE 1. Structural characteristics of the four stands of button mangrove *Conocarpus erectus* known in the southern Baja California Peninsula, Mexico. Name of each stand is followed by the estimated surface area and number of individuals.

Name of button mangrove stand	max	min	Population Canopy Cover (m^2)
1. Isla Espíritu Santo (1,420 m^2; 87 plants)			
Height (m)	4.30	0.90	
Canopy cover (m^2)	17.71	0.12	795.83
Basal trunk circumference (m)	0.45	0.04	
2. Plutarco Elías Calles (16,362 m^2; 280 plants*)			
Height (m)	9.10	1.30	
Canopy cover (m^2)	51.62	0.56	9,100.60
Basal trunk circumference (m)	0.62	0.08	
3. Migriño (7,500 m^2; 225 plants*)			
Height (m)	5.10	1.40	
Canopy cover (m^2)	12.87	0.30	8,257.50
Basal trunk circumference (m)	0.94	0.09	
4. La Salina (27,000 m^2; 2,160 plants*)			
Height (m)	4.30	0.90	
Canopy cover (m^2)	15.58	0.66	38,017.20
Basal trunk circumference (m)	0.59	0.11	

* Inference based on 20 x 10 m^2 sampling and Google Earth (2007) view analysis

main stem in most of the population (the larger mangroves) and the meager accumulation of deadwood and few dead plants. Freshwater draining from a neighboring area used for cattle grazing seems to contribute to suitable soil humidity. Measurements of height, two canopy diameters, and the basal perimeter of the trunk are shown in Table 1.

Site 3: Migriño (23°01'48.7"N, 110°04'54.9"W; MIG in Fig. 1)

This is a peculiar site, located 45 m above sea level along the banks of a sandy arroyo in a strip of pure mangrove vegetation that is 250 m long. A freshwater spring is located immediately above the upper tip of the strip, and this is probably the basis for this patch of vegetation. The shore is almost 1 km west of this site.

According to informants, this is an ancient population. An accumulation of litter and deadwood prevails throughout the patch and some dead trunks are >0.60 m in circumference. Young mangrove grows along the borders of the stand and in the downstream edge of the stand. The stand is actively growing and the thick canopy, which blocks sunlight reaching the interior, prevents seedlings from growing. Main trunks are continuously being buried by bed load sandy sediments deposited after heavy rains.

Site 4. La Salina (23°35'08.1"N, 109°32'12.3"W; LSA in Fig. 1)

This is the biggest and undoubtedly the oldest button mangrove stand on the Peninsula. It is located in a salt marsh on the Gulf of California coast that is irregularly flooded. The salt marsh has a perimeter of about 2.2 km with a surface area of about 6 hectares. No other species of mangrove is present. This population receives a small inflow of freshwater to this micro-basin. Occasionally, sea swells break through the dune strand and introduces seawater to the marsh. Deposits of detritus border the deeper part of the lagoon. During a recent flood, water reaching 2 m in depth remained for 2–3 months and killed the foliage of the covered button mangrove. This strip of mangrove is 900 m long.

In summary, this species has responded positively to the recent events of heavy rains and the decade of the 1990s with two "El Niño" events that impacted the Peninsula. Even more recently, four hurricanes have brought flooding. The coastal areas have been favored with suitable levels of soil moisture that enabled this species to colonize new areas or trigger vigorous growth.

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REFERENCES

Dawes, C.J. 1997. Marine botany, 2nd. Ed. John Wiley & Sons. New York, NY.

Félix-Pico, E.F., O.F. Holguín-Quiñónez, L. Godínez-Orta, and N.A. Santa-María-Gallegos. 2005. 3. Estructuras de las comunidades de Mangles de Bahía de Loreto, Isla de La Paz, Isla Espíritu Santo y Costa Oriental de la Bahía de La Paz. Libro de Resúmenes del I Taller sobre Manglares de la Península de B.C., La Paz, B.C.S., Pp. 9–10.

Google Earth. 2007. Google Earth™ Mapping Service.

Lugo, A., S. Brown, and M.M. Brinson. 1988. Forested wetlands in freshwater and saltwater environments. Limnol. Oceanogr. 33:894–909.

Robertson, A.I., D.M. Alongi. 1992. Coastal and estuarine studies: Fourth tropical mangrove ecosystems meeting. American Geophysical Union, Washington, DC.

Tomlinson, P.B. 1986. The botany of mangroves. Cambridge University Press, Cambridge, U.K.

Turner, R.M., J.E. Bowers, and T. Burgess. 1995. Sonoran desert plants: an ecological atlas. University of Arizona Press, Tucson.

Wiggins, I.L. 1980. Flora of Baja California. Stanford University Press, Stanford, CA.